DOCUMENT RESUME

ED 444 818 SE 063 637

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TITLE Improving Science Teaching Self-Efficacy of Elementary Preservice Teachers.
PUB DATE 1999-00-00
NOTE 16p.
PUB TYPE Reports - Research (143)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Education; *Elementary School Teachers; Faculty Development; Higher Education; *Science Instruction; *Self Efficacy; *Student Teachers; *Teacher Education
IDENTIFIERS National Science Education Standards

ABSTRACT

This paper questions the claim that the site-based approach can produce more effective beginning teachers, the ones capable of identifying and solving problems through multiple effective and appropriate approaches, and discusses the reasons that support this claim. The study uses the Science Teaching Efficacy Belief Instrument (STEBI-B) to measure preservice teachers' beliefs about science teaching. Quantitative data collected through interviews and questionnaires for 10 experience clusters include methods class assignments, methods text, methods class instruction, methods class instructor, feedback from the site-based teacher, feedback from the cluster coordinator, teaching experience in a methods class, teaching experience in an assigned classroom, and other experience during the semester. (Contains 26 references.) (YDS)

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ED 444 818

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by
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IMPROVING SCIENCE TEACHING SELF-EFFICACY OF ELEMENTARY PRESERVICE TEACHERS

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Current reform in both teacher education and science education has focused on the need for improvement of preservice teacher training (APA, 1993; Blosser, 1989; Sivertsen, 1993). The National Science Education Standards (1996) includes a chapter titled "Standards for Professional Development for Teachers of Science" that emphasizes the need to prepare future science teachers who are capable of carrying out the extensive reform guidelines. In fact, "science education of preservice elementary school teachers is seen as a critical component in the systemic approach necessary to make real and lasting change a classroom reality" (Raizen, 1994, p. 7).

Recommendations for model preservice programs include: revised science courses designed for teachers that combine content and methods (National Research Council, 1996; Prestt, 1992; Yager & Penick, 1990), exposure to a variety of teaching experiences (Lunetta, 1975; Sunal, 1980) and an emphasis on improving preservice teacher attitudes regarding science teaching (Cox & Carpenter, 1989; Lucas & Dooley, 1982). One trend in preservice teacher education suggests an increase in site-based experiences in which authenticity and knowledge through action and reflection (praxis) are seen as central components. This paper will review pertinent literature and report findings associated with a study of the effects of these site-based preservice teacher experiences on science teaching self-efficacy beliefs.

Self-efficacy, a situation-specific construct, has been used in an array of studies to investigate factors that impact on preservice teachers' belief system and their sense of confidence as it relates to their ability to be successful teachers (Tschannen-Moran, Hoy, & Hoy, 1998). This study will examine the effects of a one semester site-based program where preservice teachers participated both in methods classes and in authentic classroom and school experiences. The site experiences

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included numerous teaching opportunities within the assigned classroom and during the methods classes. Preservice teachers received evaluations of these teaching experiences from the university cluster coordinator, methods instructor, site-based teacher and peers.

Perspectives of Site-based Teacher Education

Sykes (1997) offers a simple but important generalization: one studies education at the university and learns how to teach in a school. Accepting this claim, the need for a site-based teacher education approach is evident. Let's first contextualize the current basis of site-based teacher education within a larger frame. The dichotomy shown in Figure 1 is informative.

Figure 1. Models of Professional Education

The Traditional Approach	**The Site-based Approach**
* Preparation in University Settings	* Preparation Centered in Workplace
* Transmission of Knowledge Base	* Focus on Initial Teacher Competencies
* Application of Knowledge Base	* Competencies Developed through Experience and Reflection
* Supervised Practice in Selected settings	* Increased Responsibility for Districts, Schools, Teachers
* Control Vested in Faculties of Education	* Professional Development that is responsive to Teacher needs/ School needs

Site-based teacher education attempts to merge educational theory and practice through university-school partnerships. It occurs on-site and focuses on initial teacher competencies developed through experience and reflection. This also suggests that site-based administrators and faculty have an enlarged role. Berliner (1984) has suggested that professional teacher preparation programs should involve "live students to whom to teach concepts, where expert teachers can provide critiques of the lessons, and where the peers of the novice teachers and the

children themselves can join in the analysis of the teaching activities that have just occurred." Freire (1982) calls for praxis, a process of action and reflection.

This paper expands the site-based premise with the following claim: the site-based approach can produce more effective beginning teachers, ones capable of identifying and solving problems through multiple effective and appropriate approaches. Let's first list and then discuss the reasons supporting this claim.

* **Authenticity:** Real settings provide a richer, more powerful context for linking theory to practice and practice to theory, developing preservice teachers' personal repertoire of images, knowledge, and craft.

* **Educational Realism:** Real settings provide sharper, more grounded images and information about educational settings, teaching-learning transactions, and today's school children and their communities.

* **Mutual Impacts and Outcomes:** Real settings provide inductive opportunities for both universities and schools to mutually enrich each other.

* **Pedagogical Eclecticism:** Real settings provide an experiential vehicle for the examination of multiple educational theories, voices, and practices. This inclusiveness assumes multiple explanations, the whole-brain construction of understanding, and permits the selection of solutions reflectively. In this sense preservice teachers are theory builders, not theory users.

* **Multiculturalism:** Real settings provide for the expansion of teacher education into communities of children, parents, and their neighborhoods, providing the cultural and sociolinguistic dimensions that are impossible to improvise in a campus-based approach and that are critical for the understanding and remediation of school failure.

* **Collaboration:** Real settings foster networks of individuals and entities that function in many personal and programmatic (and often unforeseen) channels and dimensions.

Clearly, the advantages of a site based teacher education program are many. Benefits to the university and to the site are noted. In addition, the observation of increased self-efficacy of the preservice teachers throughout the semester is evident. This can be explained through an understanding of the theoretical framework of self-efficacy.

Theoretical Framework of The Self-Efficacy Construct

Self-efficacy, a component of social learning theory, is a psychological construct concerned with judgments about how well one can organize and execute courses of action required to deal with prospective situations (Bandura, 1977). Bandura claims that efficacy expectations are a major determinant of choice of activities, how much effort is expended, and how the effort is sustained in those activities. In Bandura's view self-efficacy is impacted by performance accomplishments, vicarious experience, verbal persuasion, and various physiological states. Unlike locus of control, the level and strength of self-efficacy seems to vary in specific situations. A complete discussion of self-efficacy is beyond the scope of this paper. The reader is directed to Tschannen-Moran et al. (1998) for a recent treatment of the literature.

Self-efficacy theory provides the educational researcher with perhaps the strongest indicators of subsequent classroom behaviors. This linkage is critical in the educational reform process in which theory is bridged to practice leading to improved educational quality and performance. Perceived self-efficacy theory has been researched in various domains from therapeutic conditions to educational settings. Results of experimental studies on therapeutic conditions have been consistent: The cognitive mechanism of perceived self-efficacy influences personal judgment about ability and competence in performing tasks. Moreover, these studies have indicated ways in which an individual's self-efficacy can be enhanced. In education, the construct of teachers' sense of efficacy has been correlated with various measures or teacher effectiveness, including classroom behaviors, attitudes, commitment and reactions to classroom problems (Ashton, Webb & Doda, 1983; Evans & Tribble, 1986).

A number of correlational studies on the efficacy of preservice teachers suggest that efficacy varies as teachers acquire skills and experience (Guyton, Fox & Sisk, 1991). However, the relation between preservice teachers and their performance has not been fully examined. Under experimental conditions of learning how to teach reading, the self-efficacy of preservice teachers has found to be influenced by the type of instruction and feedback received (Gorrell & Capron, 1990). These results offer critical evidence that the type of instruction provided in teacher education influences the preservice teachers sense of efficacy for teaching. Positive correlations have also been established between student teachers' sense of teaching efficacy and ratings by their supervisors.

Teachers' sense of efficacy refers to situation-specific expectations in which they can help students learn (Ashton, 1984). Teachers' efficacy influences not only choices of activities but also the amount of effort expended and the level of persistence in the face of obstacles. Thus, there is a clear linkage between a teachers' positive personal efficacy and student achievement. Finally, as an important component in science education reform, "science anxiety and efficacy and strategies that reduce anxiety and increase efficacy are worthy of attention in teacher education if we wish to improve the quality, quantity and success of science curriculum and instruction" (Czerniak & Chiarelott, 1990, p.55).

Methods

In an effort to assess the effectiveness of the site-based teacher education program, this descriptive study identified the factors in the site-based experiences that affected preservice elementary teachers' self-efficacy. As a situation specific construct, science teaching self-efficacy studies have been conducted to investigate factors that impact preservice teachers' beliefs and their sense of confidence as it relates to their ability to become successful science teachers. (Proctor, 1994; Tosun, 1994; Watters & Ginn, 1995).

The study used the Science Teaching Efficacy Belief Instrument (STEBI-B) to measure the preservice teachers' self-efficacy beliefs about science teaching (Enochs & Riggs, 1990). Two

separate constructs were measured as defined by Bandura's theory. A science teaching outcome expectancy scale (STOE) and a personal science teaching efficacy scale (PSTE) made up the 23-item Likert-type survey. Levels of agreement with each statement varied from "strongly agree" to "strongly disagree" on a five-point scale. Acceptable validity and reliability criteria were established for the STEBI-B by the developers. (Cronbach's alpha coefficient of .90 was obtained for the PSTE scale and an alpha of .76 was obtained for the STOE scale). A follow-up questionnaire was administered to determine subjects' perceptions of the sources of efficacy and obtain open-ended comments about their field-based experiences. Finally, a sample of the population was interviewed as a cross-reference to the quantitative data.

Data Source

The study included the entire population (n = 131) of undergraduate elementary preservice teachers in the site-based teacher education program at the University of Houston during the fall of 1997. The 131 paired, pretests and posttests of the STEBI-B were analyzed for significance in mean score gains. The treatment consisted of a fifteen-week, four and a half day per week program in which six groups of preservice teachers undertook site-based experiences in twenty-two different elementary schools. Fifteen hours per week were given to university methods classes conducted on-site where, to varying degrees, school children, teachers, instructional materials, and classrooms were utilized by university faculty. During the remaining time (two days per week) preservice teachers were assigned to classroom teachers who served as mentors. The end of the semester culminated in teaching opportunities within the site-based classroom. Observations and evaluations of the preservice teacher were conducted by peers, the university coordinator, methods instructor and the site-based teacher.

Results/Conclusions

Results of the paired t tests yielded a t value of 11.52 which is significant at $p<.001$. The mean score gain between pretest scores and posttest scores was + 10.20. An analysis of

covariance using the pretest as a covariate yielded an F value of 6.41 which was statistically significant at p<.001. Significant differences were found both in terms of science teaching outcome expectancy statements and in terms of personal science teaching efficacy statements. In fact, the efficacy mean gains were substantial among those reported in the science education literature (Tosun, 1994; Watters & Ginn, 1995). Results of the mean score gains in the STEBI-B by clusters are shown in Table 1. Results of mean score gains for each construct of PSTE and STOE are shown in Tables 2 and 3.

Table 1

Results Obtained from t test for Paired Samples for STEBI-B.

Cluster		pretest		posttest				
	N	Mean	SD	Mean	SD	*t*	*p*	Δ
1	17	83.82	10.85	95.82	6.91	4.78	<.001	1.11
2	22	81.59	7.48	96.41	6.47	7.08	<.001	1.98
3	27	84.63	9.25	93.89	8.74	5.02	<.001	1.00
4	23	85.08	11.33	98.78	10.05	9.20	<.001	1.21
5	22	79.36	7.84	87.14	9.31	4.31	<.001	.99
6	20	82.10	7.26	86.10	12.37	1.41	.175	.55
Total	131	82.89	9.22	93.09	10.18	11.52	<.001	1.11

Table 2

Results Obtained from t test for Paired Samples for PSTE.

Cluster	N	pretest Mean	SD	posttest Mean	SD	t	p	Δ
1	17	47.59	8.17	55.35	5.06	4.66	<.001	.95
2	22	45.27	6.11	55.95	5.14	7.62	<.001	1.75
3	27	48.81	6.70	54.67	5.99	4.05	<.001	.87
4	23	48.57	7.99	57.26	6.09	7.76	<.001	1.09
5	22	44.05	6.84	50.18	6.76	4.10	.001	.89
6	20	45.90	6.31	48.80	9.15	1.34	.196	.46
Total	131	46.77	7.12	53.78	7.06	10.67	<.001	.98

Table 3

Results Obtained from t test for Paired Samples for STOE.

Cluster		pretest		posttest				
	N	Mean	SD	Mean	SD	*t*	*p*	Δ
1	17	36.24	5.02	40.47	3.10	3.27	.005	.84
2	22	36.31	4.47	40.45	3.90	4.06	.001	.93
3	27	35.81	4.76	39.22	3.86	4.65	<.001	.72
4	23	36.52	4.50	41.52	5.27	6.70	<.001	1.11
5	22	35.32	4.03	36.95	4.73	2.08	.050	.40
6	20	36.20	4.51	37.30	5.52	1.15	.263	.24
Total	131	36.05	4.49	39.32	4.71	8.56	<.001	.73

These quantitative results were supported by interviews and written comments on questionnaires that determined the ratings for the extent of impact on self-efficacy from site-based experiences. The survey results from the questionnaire distributed at the final science class meeting were tabulated for the rating of variables by each cluster. Ten experiences were listed for the preservice teacher student to evaluate. The perceived impact on the increase in science teaching efficacy was rated from no extent (1) to great extent (5) for each experience. The results are presented in Table 4.

Table 4

Impact of Site-Based Experiences

EXPERIENCES by CLUSTER	1	2	3	4	5	6
1) Methods class assignments	4.59	4.48	4.48	4.26	3.18	2.95
2) Methods text	3.18	3.30	2.96	3.70	3.01	2.14
3) Methods class instruction	4.82	4.65	4.70	4.43	4.05	3.62
4) Methods class instructor	4.76	4.83	4.85	4.52	4.14	3.81
5) Observation of SBTE	3.76	4.39	3.78	4.04	2.77	2.29
6) Feedback from SBTE	4.06	4.30	3.63	4.26	2.91	2.05
7) Feedback from cluster coordinator	4.29	4.39	4.33	4.35	1.36	2.05
8) Teaching experience in methods class (cooperative group work, explanations,presentations, work with students)	4.81	4.70	4.41	4.30	2.95	3.43
9) Teaching experience in assigned classroom	4.76	4.78	4.11	4.70	3.50	2.52
10) Other experience this semester	4.65	4.56	4.05	4.23	2.80	2.12

Results indicated that the experiences of the site-based preservice program had a significant impact on the preservice teachers beliefs of self-efficacy. The study results show that the science teaching self-efficacy was positively impacted by the performance accomplishments of authentic teaching experiences. Additional factors that positively impact self-efficacy were also present in the site-based situation. Preservice teachers had the opportunity to observe teaching episodes of classroom teachers, the methods instructor, and peers. This observation provided the vicarious experience that Bandura credits with building self-efficacy. Finally, the feedback from the cluster coordinator and site-based teacher educator supplied the verbal persuasion and psychological states that also enhance self-efficacy. Feedback from the methods instructor, site-based teacher, peers and university cluster coordinator were mentioned as helpful and significant. The preservice teachers also noted that students reactions and enthusiasm in the science classroom encouraged them to continue to teach science in the future.

Implications

The implication for teacher educators is that this specific affective dimension can be significantly enhanced. The site-based program can provide the four factors Bandura identified as sources of information used to determine self-efficacy. The site-based experiences provide performance accomplishments through mastery teaching experiences, vicarious experiences through observation of peers and the site-based teachers, and social persuasion, enhanced physiological and emotional states from constructive feedback. The majority of these preservice teachers started the semester with a negative attitude toward teaching science, but they ended the semester with a positive view of themselves as effective science teachers in the future. In fact, when interviewed about their perceived ability to teach science in the future, one student replied, "Now I really can teach it! I've done it - I have proof that it does work - some of these techniques that we've been talking about and now I can walk in there - I know the exact steps - its incredible what this semester has done for me!"

The findings offer support for the growing trend to conduct preservice professional development education in a site-based context. This postmodern format implies that the shared power, control, and mission of university-school site-based collaborations can lead to important changes in preservice teacher education.

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